Invisible gold in pyrite and pyrrhotite from epithermal, BIF-hosted and sedimentary gold deposits

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Microbeam techniques have been increasingly applied to investigate the presence of gold in sulfides associated with lode gold deposits [e.g., 1]. We have examined Au concentrations in pyrite and pyrrhotite grains of ore samples from epithermal, BIF-hosted and sedimentary gold deposits by secondary ion mass spectrometry (SIMS).

Materials: Pyrite is the principal and most abundant sulfide, and ubiquitous throughout the high-sulfidation epithermal deposits in the Nansatsu district, Japan. Mineral paragenesis of the deposits includes quartz, alunite, enargite-luzonite, covellite and electrum other than pyrite. Pyrite and pyrrhotite are from the Kalahari Goldridge deposit hosted by banded iron formation (BIF). Pyrite grains are also from sedimentary gold deposits in the Witwatersrand gold field.

Methods: Quantitative microanalyses (3 μm by 3 μm field) of pyrite and pyrrhotite were conducted by SIMS. Calibration of gold concentration was using external standard samples of pyrite and pyrrhotite that were implanted with Au ions, and the relative sensitivity factors were determined. The detection limit for Au analysis is very low (50 ppb), which enables to elucidate spatial distribution of Au. As microanalyses were also conducted for several pyrite grains.

Discussion of Results: SIMS measurements revealed that the Au and As concentrations in pyrite varied from 0 to 100 ppm and from 0 to 0.1 wt%, respectively for high-sulfidation epithermal deposits. They are compared to those of the low-sulfidation epithermal high-grade Hishikari deposit where Au and As concentrations in pyrite are from 0.1 to 2,800 ppm and from 0 to 7 wt%, respectively [2]. Au concentrations in pyrite and pyrrhotite are up to several ppm for the Kalahari Goldridge BIF-hosted gold deposit, and Au there might sometimes exist as nanoparticles (NPs). Au concentrations in pyrite for the Witwatersrand gold field are sub-ppm, and fluctuate in depth profiles, suggesting the presence of NPs.

[1] Cabri & McMahon (1995) *Can. Miner.* **33**, 349-359. [2] Morishita *et al.* (2018) *Ore Geol. Rev.*, **95**, 79-93.